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CONSIDERATIONS ON FISHERY OCEANOGRAPHY

by
Z. Popovici

FISHERIES DIVISION, BIOLOGY BRANCH
FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, January 1963

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FAO Fisheries Biology Report FB/R (No.)
FAO Fisheries Biology Synopsis FB/S (No.)

Special groups of synopses are identified by the following symbols:

CART Information concerning the living aquatic resources of certain countries and regions.

SAST Data concerning certain species and fish stocks.

MAST Methods and subjects synopses.

OT Oceanography synopses.

IT Limnological synopses.

Des catégories spéciales d'études synoptiques sont identifiées à l'aide des symboles suivants:

CART Renseignements sur les ressources aquatiques vivantes de certains pays et régions.

SAST Données sur certaines espèces et populations de poissons.

MAST Etudes synoptiques sur des méthodes et des sujets particuliers.

OT Etudes océanographiques.

IT Etudes limnologiques

Los grupos especiales de sinopsis se distinguen con las siguientes siglas:

CART Información sobre los recursos acuáticos vivos de algunos países y regiones.

SAST Datos relativos a ciertas especies y poblaciones.

MAST Sinopsis sobre métodos y materias.

OT Sinopsis sobre oceanografía.

IT Sinopsis sobre limnología.

FAO Fisheries Biology Technical Paper FB/T (No.)

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RE Indexed lists of names and addresses of experts and institutions drawn from the Registers of Experts and Institutions maintained by Biology Branch.

CB The "World List of Periodicals for Aquatic Sciences and Fisheries", Meetings and Activities Sections from, and the Handbooks for, the "Current Bibliography for Aquatic Sciences and Fisheries", special bibliographies and technical papers concerning documentation and bibliographic problems.

MFS Provisional editions of volumes or sections of "FAO Manuals in Fisheries Science".

Numbers following the symbols are for classifying the document, using the codes of the indexes to the "Current Bibliography for Aquatic Sciences and Fisheries".

Some documents may carry other identification numbers, if, for example, they have been contributed to a meeting for which papers have been marked according to another system; in requesting copies it is sufficient, however, to quote the "FB" number given at the top right-hand corner of the title page.

Des catégories spéciales de documents techniques sont identifiées à l'aide des symboles suivants:

RE Listes indexées des noms et adresses d'experts et institutions tirés des Registres des Experts et des Institutions tenus à jour par la Sous-Division de la Biologie.

CB Le "Répertoire mondial de périodiques concernant les sciences aquatiques et la pêche", les Sections des Réunions et Activités, tirées de la "Current Bibliography for Aquatic Sciences and Fisheries", le manuel de cette bibliographie ainsi que des bibliographies particulières et des articles techniques sur les problèmes de documentation et de bibliographie.

MFS Editions provisoires de volumes ou sections des "Manuels FAO de la science des pêches".

Les chiffres qui accompagnent les symboles sont destinés à la classification du document au moyen des codes d'indexation de la "Current Bibliography for Aquatic Sciences and Fisheries".

Il arrive que certains documents portent d'autres numéros d'identification, comme c'est le cas s'ils ont été préparés pour une réunion dont les documents ont été marqués à l'aide d'un autre système; mais lorsque l'on demande des copies de ces documents il suffit de mentionner le numéro "FB" figurant en haut et à droite de la page de couverture.

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RE Listas clasificadas de nombres y direcciones de expertos tomados de los Registros de Expertos y de Instituciones que se llevan en la Subdirección de Biología.

CB La "Lista mundial de publicaciones periódicas referente a las ciencias acuáticas y a la pesca", las Secciones de Reuniones y Actividades de la "Current Bibliography for Aquatic Sciences and Fisheries", el manual para su manejo, bibliografías especiales y los trabajos técnicos sobre problemas de documentación y bibliografía.

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Oceanography - General

CONSIDERATIONS ON FISHERY OCEANOGRAPHY

by

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FISHERIES DIVISION, BIOLOGY BRANCH
FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, January 1963

PREPARATION OF THIS DOCUMENT

Originally contributed to the meeting of the SCOR Working Party on Fisheries Oceanography (Bergen, 10-14 September 1962) and reproduced as a working document for submission to and discussion by the First Meeting of the FAO Advisory Committee on Marine Resources Research, to be held in Rome in January 1963.

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Considerations on fishery oceanography

Briefly reviews and defines the scope of fisheries oceanography and discusses the progress achieved with recommendations for further accomplishments in oceanography as well as related disciplines.

Project No.
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CONSIDERATIONS ON FISHERY OCEANOGRAPHY

By

Z. Popovici

INTRODUCTION

The Scientific Committee on Oceanic Research decided during its meeting held in Monaco in November 1961 to appoint a SCOR Working Group on Fisheries Oceanography with the following terms of reference:

1. To discuss and define the subject of fisheries oceanography.

2. To state what fisheries oceanography has accomplished.

3. To state what fisheries oceanography should be trying to accomplish.

4. To state what progress is needed in other sciences so that the aims set out in 3 can be attained.

5. To communicate the statements through SCOR to interested laboratories and organizations.

The author has been invited to contribute to this work. The following lines contain a number of considerations on fishery oceanography and its further development.

1. WHAT IS FISHERIES OCEANOGRAPHY?

The original name of fisheries oceanography was "Fisheries Hydrography" and its use was started with the work of the International Council for the Exploration of the Sea in Copenhagen. Within the frame of work of the Council, fisheries hydrography included the physical and chemical aspects of the fishery science and practice. The study of the sea and of fish was undertaken with the purpose of understanding the causes of fluctuations in abundance and to obtain the necessary knowledge to predict the availability of local and migratory fishes in time and space.

Later on, the advancement of ecology brought with it the concept that the fish populations, as well as the other organisms, are intimately associated with the type of water and conditions of the region in which they live, so that changes in their distribution and fluctuations in their abundance could be understood and explained only after having obtained sufficient information on the relationship between these resources and the physical, chemical and biological processes in their environment. Thus the problems of relationship of the environment to the availability and changing abundance of fishes became a prime purpose of fishery science, and this brought with it the need to intensify the study of the marine environment. This research was growing rapidly and the general knowledge of oceanographic conditions was getting better. Some of the principles governing the processes in the whole ocean are known by now and they help to understand how longer period changes in the oceanic climate affect the occurrence of fish and other living organisms in the different parts of the world ocean. But this research is being done often in areas of interest for fisheries, without participation of fishery scientists.

These scientists admit that fisheries problems are easier solved when physical and chemical data on environment are taken concurrently with biological data, because this procedure respects the factor "time" and helps to explain better the intimate association between fish and certain types of water as well as the effects of even small changes in the environment on the behaviour of the fish. Fishery scientists also admit that some aspects of the general oceanography are of more importance to their scientific problems and to fisheries than other. Therefore they prefer to work in a well coordinated team together with oceanographers.

Historically, Hydrography is older than Oceanography and therefore, the term fishery hydrography is considered by many specialists as more adequate. But, the present definition of oceanography is such that hydrography remains included in it and therefore the change of the name of fisheries hydrography into fishery oceanography may be well justified.

If we accept the definition of oceanography given by the U. S. National Academy of Science Committee on Oceanography as being "the science which studies the oceans, their boundaries, and content", and if we also agree that this science can be subdivided in: meteorological, physical, chemical, and biological oceanography, then, we can assume that the fishery science requires contributions of knowledge from all these subdivisions and uses them with the specific purpose of solving clearly defined problems of fisheries.

The dependency of this science upon other sciences is not unique. General Oceanography also depends upon other sciences and the same applies to Ecology and a number of other disciplines. In the same way, fishery oceanography depends upon general oceanography and fishery science, being a link between them.

Yet there exists by now a great divergence of opinions, which could be grouped as follows:

(1) the term fishery oceanography includes the whole field of fishery science;
(2) the term should have a restricted use, and be applied to a small part of physical oceanography;
(3) the term fishery oceanography doesn't have the right to exist at all, being only applied to general oceanography.

I defend the concept that the term "fishery science" should be maintained as distinct from the term "fishery oceanography", because each has a reasonably well defined objective and unity of purposes. Indeed:

Fishery Science is the study of the living aquatic resources, of the fluctuations in their abundance in time and space and of the forms of their harvesting with their implications. It has to contribute to the solution of the acute problem of protein deficiency in the world by:

(1) description of populations living in each region where commercial fishery exists;
(2) studies of population dynamics of living aquatic resources; and of the complete biological cycle;
(3) estimations of the size and distribution of living aquatic resources;
(4) search for new fishery resources;
(5) prediction of availability of fish and other living resources in time and space, and
(6) research on the effects of man's activities on the exploited living resources, and on organisms used by them as food and on the rest of marine communities.

Fishery Oceanography utilizes the basic data from oceanography and fishery science to establish and explain the relationship between the ever-changing meteorological and oceanographic processes, and aquatic populations. It studies the links between physical, chemical and biological factors as well as the effects of the changes on the potential fertility of the sea and on the abundance, distribution and behaviour of all the organisms making up what we call "living resources of the sea".

Considering the actual work of an oceanographer in a team of fishery scientists as a point of departure, I propose to define fishery oceanography in the following terms:

> "Fishery Oceanography is the study of physical and chemical factors and processes in and near the ocean which have or may have a bearing on the basic capacity of the sea to produce organic matter, as well as on the living resources and on activities related to their harvesting".

Purposes: The main purposes of fishery oceanography are:

- To obtain knowledge on the physical and chemical factors and processes of the marine environment which have or may have a bearing on the production of organic matter and on the behaviour, distribution, abundance and availability of living resources. By this way it should establish the links between physical and chemical factors and marine organisms.

- To study the factors responsible for the high potential fertility of certain areas of the sea (like upwelling and abundant nutrient supply to the photic layer, mixing, presence of boundaries, eddies, etc.).

- To locate by means of echo-sounding the places and depths of massive concentrations of fishes, and to establish the periods in which they occur and the oceanographic conditions of the environment which are favorable to these phenomena.

- To study the relationship between variations in the oceanic circulation and the major changes in the distribution of fish populations.

- To achieve a broader knowledge on the principles governing the natural phenomena in or near the sea which cause major fluctuations in the populations of living resources.

- To predict major changes which will take place in the physical conditions of the environment and in the abundance of living resources and which could have a bearing upon the harvesting activities of man.

The sum of the broadly outlined purposes show that fishery oceanography is nothing else but oceanographic research carried out with the purpose of satisfying the needs of fishery science. It covers in reality all oceanographic phenomena which influence the production potential, the populations of living resources and the results of their harvesting and it leads to a better understanding of the inter-relationship between processes in the marine environment and marine organisms in general.

Farming of marine organisms was not mentioned, because I consider its special and more advanced form of harvesting living aquatic resources thus, an activity which also belongs to fishery.

2. WHAT HAS THE FISHERY OCEANOGRAPHY ACCOMPLISHED?

2.1 Cooperation and integration of marine sciences

Because of the urgent need to explain the vehaviour of the living resources of the sea in an ever-changing environment, fishery scientists and oceanographers contributed to a better cooperation among marine scientists and to the integration of the marine sciences as well as to the building of the oceanographic research endeavour which takes the ocean as a unit.

2.2 Role as pioneer of the general oceanography

In many parts of the world, fishery oceanography is the unique branch of oceanography which is active, because local authorities have an interest and understanding for its development. The impact of fishery oceanography on universities has been extraordinary during past years, especially in Ecuador and Peru, where the unique places for adequate training of students are the Marine Resources Research Institutes, created with the assistance of the Special Fund of the United Nations and having FAO as Executive Agency.

2.3 Progress of knowledge

Fishery oceanography increased the oceanographic knowledge in many parts of the world by discovering unknown currents and undercurrents, banks and areas where certain oceanographic characteristics stimulate major concentrations of marine organisms. The contribution has been outstanding in nearshore areas.

2.4 Aid to fishermen

In the practical field, fishery oceanographers told fishermen under which environmental conditions could they make better captures, how to use the echo-sounding equipment and in which areas exist major concentrations of fish accessible for exploitation. In some cases predictions on fish abundance have also been made.

3. WHAT SHOULD FISHERY OCEANOGRAPHY TRY TO ACCOMPLISH?

It should try to obtain new information on environmental conditions which may have a bearing on the living resources of the sea, their seasonal distribution and availability, as well as on their most economic harvesting. Such information concerns the following aspects:

3.1 Food producing capacity of the sea:

Fishery Oceanography should try to bring together good and usable data on the structure of the sea and on the processes which maintain and determine its food producing capacity in nearshore areas as well as in oceanic areas.

3.2 Fishery resources:

It should increase knowledge on existing fishery resources, especially in tropical waters in relation to the main oceanographic characteristics of each region.

It should try to locate the areas of concentration of fishery resources and to establish the oceanographic causes of the shifting of the limits of such areas, when and where this may occur.

3.3 Synopsis, Catalogues and Atlas:

In relation to the great endeavour of assessment of living fishery resources, fishery oceanography should contribute to develop:

(1) Oceanographic Synopsis of the regions which present interest to fishing activities;
(2) Seasonal fishing charts for pelagic and demersal resources; and
(3) Atlas representing the oceanographic characteristics of the fishing areas.

The work on these lines started by FAO in cooperation with fisheries commissions and individual scientists should be intensified.

3.4 Fish-eggs and larvae:

Fishery scientists should intensify the research on fish-eggs and larvae, especially in the sea areas where new fishing activities are being started, and fishery oceanographers should investigate the influences of currents and eddies on transport, dispersion and survival of the larvae. Such influences may present interesting aspects in the region of trade winds and monsoons.

3.5 Pollution problems:

Fishery oceanography should intensify research on oceanographic factors which may contribute to the dilution or concentration of pollutants (organic wastes and atomic wastes) in oceanic regions, where major interest of fisheries exists.

3.6 Plankton Blooms:

Fishery oceanography should intensify research on the oceanographic conditions of the areas with frequent plankton blooms and, in connection with it, try to establish the causes of poisonous plankton blooms and their effects on environment, living marine resources and man.

3.7 Anomalous conditions and mass mortalities:

Anomalous changes in some of the environmental conditions which produce mass mortalities of marine organisms should be established.

3.8 Boundary processes and limiting factors:

Fishery oceanography should increase the research effort on boundary processes between the atmosphere and the sea and on processes in the sea that may influence the behaviour and abundance of the living resources; it should try to establish the principal limiting factors of their dispersion or distribution during the successive seasons and, in general, the causes of major changes in their abundance, and the time of their appearance and residence in certain areas of the sea.

3.9 Prediction:

Fishery oceanography should try to find practical methods to predict (1) the effect of the changing environmental conditions on the marine organisms and (2) the occurrence of fish concentrations and probable directions of their migration.

3.10 Management:

It will be necessary to develop methods for the management of the exploitation of the areas rich in marine resources, in accordance with the findings of fishery science and oceanography. Proper understanding of such findings is prerequisite to the wise mangement of marine fishery resources.

In the developing countries, governmental fishery agencies should be advised that their prime duty is related to:

(1) conservation problems, and
(2) normal development of harvesting activities of aquatic living resources.

They should also be advised to base their decisions, when ever possible, on findings of fishery scientists actively engaged in research of fishery problems, when taking measures to reduce the fishing of a species with the purpose of avoiding or eliminating overfishing, and ensuring reasonably normal yields from year to year.

4. WHAT WORK IS NEEDED FROM OTHER SCIENTIFIC DISCIPLINES IN ORDER TO ADVANCE?

4.1 Ecology and Physiology of marine organisms

The interaction between the squatic organisms and their environment as well as the effects of the major changes on the living resources of the sea can be understood only after proper knowledge of the physiology and ecology of these organisms. When trying to explain correlation between certain oceanographic findings and behaviour of fish, fishery oceanographers find a great obstacle: the lack of adequate data on limits of tolerancy of fishes (as well as of other aquatic organisms) toward the factors of the physical environment and the insufficient knowledge of the behaviour of the organisms in different environmental conditions. Therefore, the whole study of the effects of environment on fish is progressing too slowly. It means that research on ecology and physiology of marine organisms should be strongly stimulated in the near future.

4.2 Oceanography

The research of ocean processes should be extended more and more to the Southern Hemisphere.

4.3 Marine Meteorology

The establishment of a network of observational points on islands along the coasts of the continents and on the high seas is required to obtain a better coverage of data on weather and surface temperature of the sea. This applies especially to the Southern Hemisphere. WMO should be invited to participate in the planning and execution of this network.

FAO FISHERIES BIOLOGY TECHNICAL PAPER

This is one of a series of Technical Papers (see inside front cover) dealing with various aspects of the work of FAO Fisheries Division, Biology Branch, including the review of pertinent information on particular topics, to meet the requests for assistance, for presentation to technical and scientific meetings, etc. Extra copies can be obtained by application to:

Research Programs Section
Biology Branch, Fisheries Division
FAO, Rome, Italy.

(Papers issued since January 1962)

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FB/T18	Fish farming methods in the Philippines, Indonesia and Hong Kong	March, 1962
FB/T19	World list of periodicals for aquatic sciences and fisheries, Vol. 1 Répertoire mondial de périodiques concernant les sciences aquatiques et la pêche, Vol. 1 Lista mundial de publicaciones periodicas referente a las ciencias acuaticas y a la pesca, Vol. 1	March, 1962
FB/T10 (Rev. 1)	A world list of experts concerned with the study of the biology of tunas and related species	April, 1962
FB/T20	List of marine research institutes in the tropics (30°N to 30°S)	June, 1962
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FB/T25	Current bibliography for aquatic sciences and fisheries Volumes 1 to 3 and 1957 Supplement Subject index (physical oceanography) Volume 1 à 4 et Supplément 1957 Index par sujet (océanographie physique) Volumenes 1 a 4 y Suplemento de 1957 Indice de materias (oceanografía física)	November 1962
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